

Claims

What is claimed is:

1. A method of transdermal thermal polymerization, the method comprising the steps of:
introducing a polymerizable material (prepolymer), and a thermal polymerization initiator into an animal's body; and
applying thermal energy transdermally for a sufficient amount of time to polymerize or crosslink the said prepolymer, or allowing the prepolymer to polymerize or crosslink using only the animal's own body heat as a thermal energy source.
2. The method of claim 1 wherein the polymerizable material is biodegradable before and after polymerization.
3. The method of claim 1 wherein the polymerizable material has unsaturated functional groups.
4. The method of claim 1 wherein the polymerizable material has functional groups selected from the group consisting of acroyl, methacroyl, allyl, and vinyl.
5. The method of claim 1 wherein the polymerizable material is a hydrogel.

The method of claim 1 wherein the polymerizable material and thermal initiator are covalently linked together.

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The method of claim 1 wherein the step of introducing comprises introducing the material and initiator under the skin, into a muscle, into a body cavity, into a potential space, or into an organ.

The method of claim 1 wherein the thermal polymerization initiator initiates polymerization between 37°C and 45°C.

9. The method of claim 1 wherein the thermal polymerization initiator is water soluble.

10. The method of claim 1 wherein the thermal polymerization initiator has limited toxicity in animals.

11. The method of claim 1 wherein the thermal polymerization initiator is an azo-based radical initiator.

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12. The method of claim 1 wherein the thermal polymerization initiator is 2,2'-azobis-[N,N'-dimethyleneisobutyramidine] dihydrochloride.

13. The method of claim 1 wherein the thermal polymerization initiator is a derivative of 2,2'-azobis-[N,N'-dimethyleneisobutyramidine] dihydrochloride.

14. The method of claim 1 wherein the step of introducing comprises injecting said prepolymer and said initiator using a syringe.

15. The method of claim 1 wherein the step of introducing comprises placing said prepolymer and said initiator during a surgical procedure.

16. The method of claim 1 wherein the step of applying thermal energy comprises applying thermal energy from a heat source selected from the group consisting of a heating pad, a water bath, a hot water bottle, a heat lamp, and a light.

17. A method of drug delivery, the method comprising the steps of:
introducing a polymerizable material (prepolymer), a thermal polymerization initiator, and a diagnostic, therapeutic, or prophylactic agent into an animal's body; and
applying thermal energy transdermally for a sufficient amount of time to polymerize or crosslink the said prepolymer, or allowing the prepolymer to polymerize or crosslink using only the animal's own body heat as a thermal energy source.

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18. The method of claim 17 wherein the step of providing an agent comprises providing a bioactive agent.

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19. The method of claim 17 wherein the step of providing an agent comprises providing a protein. ✓

20. The method of claim 17 wherein the step of providing an agent comprises providing a peptide. ✓

21. The method of claim 17 wherein the step of providing an agent comprises providing a vaccine. ✓

22. The method of claim 17 wherein the step of providing an agent comprises providing a polynucleotide. ✓

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23. The method of claim 17 wherein the step of providing an agent comprises providing an organic compound.

24. The method of claim 17 wherein the step of providing an agent comprises

20 providing an agent within a microsphere.

25. A method of tissue engineering, the method comprising the steps of:

introducing a polymerizable material (prepolymer), a thermal
polymerization initiator, and at least one living cell subcutaneously
into an animal; and
5 applying thermal energy transdermally for a sufficient amount of time to
polymerize or crosslink the said prepolymer, or allowing the pre-
polymer to polymerize or crosslink using only the animal's own
body heat as a thermal energy source.

26. A composition comprising a polymerizable material (prepolymer), a thermal
initiator, and a bioactive agent.

27. A composition comprising a polymerizable material (prepolymer), a thermal
initiator, and at least one cell.

28. The composition of claim 26 or 27 wherein the polymerizable material
(prepolymer) is biodegradable before and after polymerization.

29. The composition of claim 26 or 27 wherein the polymerizable material has
unsaturated functional groups.

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30. The composition of claim 26 or 27 wherein the polymerizable material has functional groups selected from the group consisting of acroyl, methacroyl, allyl, and vinyl.
31. The composition of claim 26 or 27 wherein the polymerizable material is a hydrogel.
32. The composition of claim 26 or 27 wherein the thermal polymerization initiator initiates polymerization between 37°C and 50°C.
33. The composition of claim 26 or 27 wherein the thermal polymerization initiator is water soluble.
34. The composition of claim 26 or 27 wherein the thermal polymerization initiator has limited toxicity in animals.
35. The composition of claim 26 or 27 wherein the thermal polymerization initiator is an azo-based radical initiator.
- 20 36. The composition of claim 26 or 27 wherein the thermal polymerization initiator is 2,2'-azobis-[N,N'-dimethyleneisobutyramidine] dihydrochloride.

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37. The composition of claim 26 or 27 wherein the thermal polymerization initiator is a derivative of 2,2'-azobis-[N,N'-dimethyleneisobutyramidine] dihydrochloride.
38. The composition of claim 26 or 27 wherein the initiator is at a concentration less than 10% by weight percent thermal initiator.
39. The composition of claim 26 or 27 wherein the initiator is at a concentration less than 3% by weight percent thermal initiator.
40. The composition of claim 26 or 27 wherein the initiator is at a concentration between 2 and 0.01% by weight percent thermal initiator.
41. The composition of claim 26 wherein the step of providing an agent comprises providing a protein.
42. The composition of claim 26 wherein the step of providing an agent comprises providing a peptide.
43. The composition of claim 26 wherein the step of providing an agent comprises providing a vaccine.

44. The composition of claim 26 wherein the step of providing an agent comprises providing a polynucleotide.

45. The composition of claim 26 wherein the step of providing an agent comprises providing an organic compound.

46. The composition of claim 26 wherein the step of providing an agent comprises providing an agent within a microsphere.

47. A system for drug delivery, the system comprising:

a polymerizable material (prepolymer);

a thermal initiator;

a bioactive agent; and

an apparatus for delivering a suspension into an animal.

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48. A system for tissue engineering, the system comprising:

a polymerizable material (prepolymer);

a thermal initiator;

at least one cell; and

an apparatus for delivering a suspension into an animal.

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49. The system of claim 47 or 48 wherein the system further comprises a heating apparatus.

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